Algorithms Group **Summer '15**
Departement of Computer Science - IBR
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Geometric Algorithms
Exercise 3
June 5, 2014

This sheet is comprised of several exercise. The solutions should be handed in by **June 11, 2015** until 19:00pm. This can be done by placing them in the appropriate box of the usual exercise locker.
In order to achieve the *"Studienleistung"*, you must achieve 50% of the points over all exercise sheets and you must have presented at least two exercises until the end of the term. Please mark those exercises that you would like to present during the tutorial.

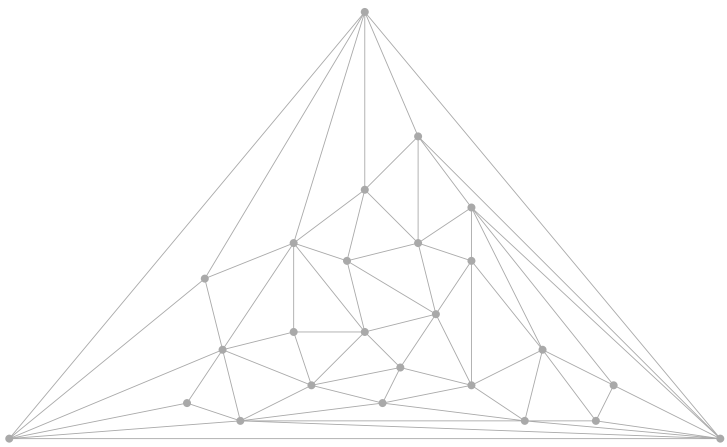
Exercise T1 (Expected Value):

Let X and Y be two independent random variables. Show that

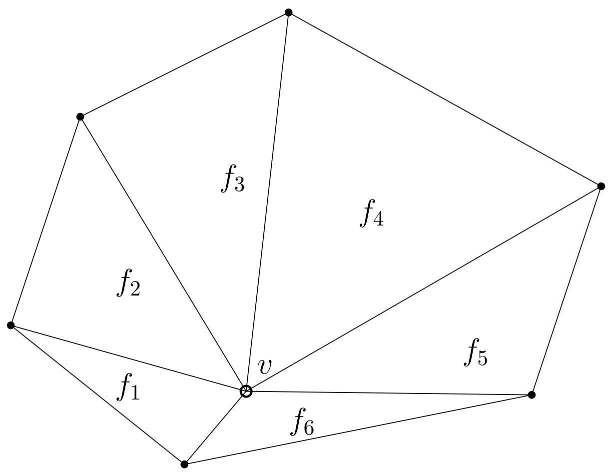
$$E[X \cdot Y] = E[X] \cdot E[Y].$$

(10 P.)

Exercise T2 (Point Location - Kirkpatrick):



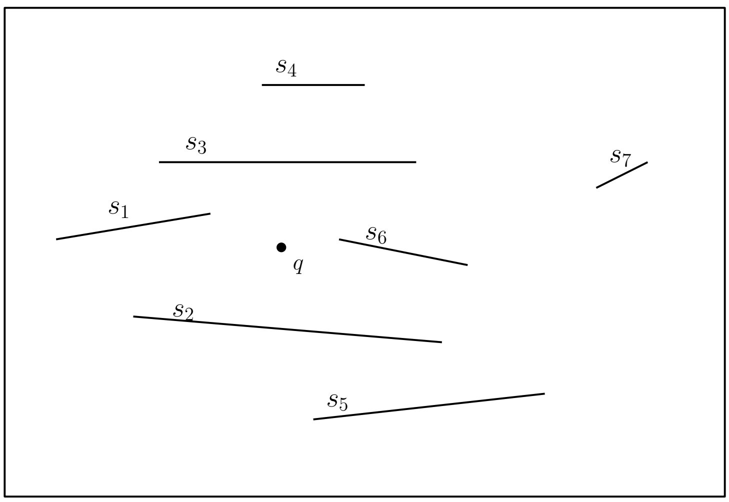
a) Given the triangulation (level 0) above. Identify a sufficiently large set of independent vertices. According to this set, give the triangulation for level 1 according to the algorithm of Kirkpatrick. Argue why the size of your set is large enough.



b) Given the fan of the vertex v above. Give a triangulation after v is removed and the parent/child relation according to algorithm of Kirkpatrick for the new/old faces.

(5+5 P.)

Exercise T3 (Planar Point Location - Trapezoidal Map):



a) Draw the final trapezoidal decomposition that is induced by the segments above.

b) Give (and prove) an insertion order of the segments such that the query path to q is minimal.

c) Give (and prove) an insertion order of the segments such that the query path to q is maximal.

(5+7+7 P.)

Exercise T4 (Trapezoidal Map - Worst Case Space Complexity):

a) Give a set of segments S and an insertion order such that the size of the search structure $D(S)$ is in $\Omega(n^2)$.

b) Prove that the required space is at most $O(n^2)$.

(5+6 P.)